

Amendments to the Specification:

Please replace the paragraph beginning at page 6, line 14, with the following amended paragraph:

~~Fig. 35 shows~~Figs. 35A-F show cross sections of various particle morphologies of some composite particles manufacturable according to the present invention.

Please replace the paragraph beginning at page 47, line 17, with the following amended paragraph:

Thus, the precursors can preferably be spray-converted at a temperature of at least about 700°C, such as from about 750°C to 950°C, to form a homogeneous admixture including one or more oxides having low crystallinity. The intermediate particles can then be heat treated at a temperature of, for example, from about 1100°C to about 1600°C, to form the substantially phase pure phosphor compounds having high crystallinity.

Please replace the paragraph beginning at page 47, line 22, with the following amended paragraph:

Particularly preferred phosphors that are produced by spray-conversion according to the present invention include doped barium magnesium aluminate (e.g. BaMgAl₁₀O₁₇:Eu or Mn), zinc silicate (e.g. Zn₂SiO₄:Mn), yttria (e.g. Y₂O₃:Eu or Tb) yttrium gadolinium borate (e.g. (Y,Gd)BO₃:Eu) and barium aluminate, for example barium aluminate doped with Mn (e.g. BaAl_xO_y:Mn). Preferred operating conditions for producing each of these phosphor compounds is detailed in Table I hereinbelow.

Please replace the paragraph beginning at page 48, line 15, with the following amended paragraph:

For the production of europium doped barium magnesium aluminate (BAM:Eu) phosphors according to the present invention, the liquid feed can include a solution of metal salts such as nitrates, chlorides, sulfates, hydroxides or oxalates of the phosphor

components. According to a preferred embodiment, BAM:Eu is formed from a precursor solution comprising barium nitrate, magnesium nitrate and fumed (particulate) alumina for the BAM host material, as well as europium nitrate to provide the Eu dopant ion or manganese nitrate to provide the Mn dopant ion. It has been found that aluminum nitrate as a precursor to aluminum oxide is not a preferred alternative due to solubility limits of barium nitrate. Therefore it is preferable to use particulate alumina, or a similar aluminum compound such as boehmite. It has also been found unexpectedly that the precursor solution should include an amount of aluminum that is in excess of the stoichiometric amount required to form BAM. In one preferred embodiment, at least about 20 atomic percent excess alumina is added to the precursor solution. This can result in a phosphor powder comprising BAM and alumina. Barium aluminate can be formed in a similar manner. About 5 to 10 weight percent of the precursors is preferred.

Please replace the paragraph beginning at page 49, line 3, with the following amended paragraph:

Preferred precursors for the production of $Zn_2SiO_4:Mn$ include metal metals-salts, particularly nitrate salts, for the Zn and the Mn. For the silica component, it is preferred to use dispersed particulate silica. It has also been found that for the production of zinc silicate that the precursor solution should include an excess of silica. It has been found that, for example, a preferred precursor solution includes an excess of about 10 atomic percent silica. This can result in a phosphor powder comprising zinc silicate and silica. It is preferred to use a precursor concentration of from about 5 to about 10 weight percent, more preferably from about 6 to 8 weight percent, based on the equivalent weight of the phosphor compound.

Please replace Table 1 at page 53, line 9, with the following amended Table I:

TABLE I Examples of Spray-Converted Phosphor Compounds

Host Material	Conversion Temperature (pyrolyzation)	Carrier Gas	Heat Treatment Temperature	Heat Treatment Gas
Y_2O_3	<u>about</u> 850-1000°C	Air	<u>about</u> 1350-1500°C	Air
$\text{BaMgAl}_{10}\text{O}_{17}$	750-950°C	Air	1200-1700°C	H_2/N_2
Zn_2SiO_4	900-950°C	Air	1100-1300°C	Air
$(\text{Y},\text{Gd})\text{BO}_3$	900-950°C	Air	1100-1400°C	Air
BaAl_xO_y Barium Aluminate	750-950°C	Air	1200-1700°C	Air

Please replace the paragraph beginning at page 53, line 18, with the following amended paragraph:

A more preferred pyrolyzation temperature for Y_2O_3 is from about 900[-] to about 950°C. Other pyrolyzation and heating treatments are possible. For example, BAM precursor particles can be heated in an oxygen-containing gas such as air at 1200-1600°C to convert the precursor to BAM, and then be heated at 1400-1650°C in a hydrogen-containing gas to reduce Eu^{3+} to Eu^{2+} . The heat treatment time is preferably not more than about 2 hours and can be as little as about 1 minute. To reduce agglomeration, the intermediate particles are preferably heat treated under sufficient agitation to minimize the agglomeration of the particles. One preferred method for agitating during heat treatment is to heat treat the powders in a rotary kiln, wherein the powders are constantly moving through a tubular furnace that is rotating on its major axis.

Please replace the paragraph beginning at page 53, line 18, with the following amended paragraph:

Although air is a preferred carrier gas for the foregoing compounds, it will be appreciated that any oxygen-containing gas can be used. A more preferred pyrolyzation temperature for Y_2O_3 is 900-950°C. Other pyrolyzation and heating treatments are

possible. For example, BAM precursor particles can be heated in air at 1200-1600°C to convert the precursor to BAM, and then be heated at 1400-1650°C in a hydrogen-containing gas to reduce Eu³⁺ to Eu²⁺. The heat treatment time is preferably not more than about 2 hours and can be as little as about 1 minute. To reduce agglomeration, the intermediate particles are preferably heat treated under sufficient agitation to minimize the agglomeration of the particles. One preferred method for agitating during heat treatment is to heat treat the powders in a rotary kiln, wherein the powders are constantly moving through a tubular furnace that is rotating on its major axis.

Please replace Table II at page 55, line 10, with the following amended Table II:

TABLE II Examples of Photoluminescent Phosphor Materials

Host Material	Activator Ion	Color
Y ₂ O ₃	Eu ³⁺	Red
BaMgAl ₁₀ O ₁₇	Eu ²⁺	Blue
Zn ₂ SiO ₄	Mn ²⁺	Green
(Y,Gd) BO ₃	Eu ³⁺	Red
<u>BaAl₆O₉</u> Barium Aluminate	Mn ²⁺	Green

Please replace the paragraph beginning at page 55, line 24, with the following amended paragraph:

According to the present invention, the phosphor powder includes particles having a small average particle size. Although the preferred average size of the phosphor particles will vary according to the application of the phosphor powder, the average particle size of the phosphor particles is preferably at least about 0.1 μm and not greater than about 10

μm. For most applications, the average particle size is preferably not greater than about 5 μm, such as from about 0.3 μm to about 5 μm and more preferably is not greater than about 3 μm, such as from about 0.3 μm to about 3 μm. As used herein, the average particle size is the weight average particle size.

Please replace the paragraph beginning at page 58, line 20, with the following amended paragraph:

The phosphor particles of the present invention are also preferably substantially spherical in shape. That is, the particles are not jagged or irregular in shape. Spherical particles are particularly advantageous because they are able to disperse and coat a device, such as a display panel, more uniformly with a reduced average thickness. Although the particles are preferably substantially spherical, the particles may become faceted as the crystallite size increases while maintaining a substantially spherical morphology.

Please replace the paragraph beginning at page 65, line 12, with the following amended paragraph:

Plasma display panels typically operate using a xenon gas composition. The Y₂O₃:Eu phosphors of the present invention, doped with from 4 to about 6 atomic percent Eu, are useful for plasma displays for providing red color. (Y,Gd)BO₃ phosphors including about 14 to 20 atomic percent Eu are also useful for red color. Further, the Zn₂SiO₄:Mn phosphors of the present invention, preferably with 0.05 to 2 atomic percent Mn, are useful for producing a green color. Further, barium aluminate with manganese, such as 8 to 12 atomic percent manganese, can be used to produce green color, particularly when xenon is used as the excitation source. BAM phosphors of the present invention are useful for producing a blue color, particularly when doped with from about 8 to 12 atomic percent Eu. It will be appreciated that combinations of the foregoing phosphors can be used in a

plasma display panel to achieve a full-color display. The phosphors can advantageously be coated, such as with MgO, to reduce degradation from the plasma.

Please replace the paragraph beginning at page 67, line 14, with the following amended paragraph:

Further, the phosphor particles according to the present invention can be used for fluorescent lighting elements, including common overhead lighting tubes as well as lamps used to backlight LCD displays, which are commonly used on laptop computers. Typically, the excitation source for such displays includes mercury vapor. Xenon gas can also be used as an excitation source.

Please replace the paragraph beginning at page 70, line 15, with the following amended paragraph:

Thick film pastes also include an organic vehicle phase that is a mixture of solvents, polymers, resins or other organics whose primary function is to provide the appropriate rheology (flow properties) to the paste. The liquid solvent assists in mixing of the components into a homogenous paste and substantially evaporates upon application of the paste to the substrate. Usually the solvent is a volatile liquid such as isopropanol, methanol, ethanol, terpineol, butyl carbitol, butyl carbitol acetate, aliphatic alcohols, esters, acetone and the like. The other organic vehicle components can include thickeners (sometimes referred to as organic binders), stabilizing agents, surfactants, wetting agents and the like. Thickeners provide sufficient viscosity to the paste and also acts as a binding agent in the unfired state. Examples of thickeners include ethyl cellulose, polyvinyl acetate, resins such as acrylic resin, cellulose resin, polyester, polyamide and the like. The stabilizing agents reduce oxidation and degradation, stabilize the viscosity or buffer the pH of the paste. For example, triethanolamine is a common stabilizer. Wetting agents and surfactants are well known in the thick film paste art and can include triethanolamine and

phosphate esters.

Please replace the paragraph beginning at page 72, line 25, with the following amended paragraph:

Ink-jet printing is another method for depositing the phosphor powders in a predetermined pattern. The phosphor powder is dispersed in a liquid medium and dispensed onto a substrate using an ink jet printing head that is computer controlled to produce a pattern. The phosphor powders of the present invention having a small size, narrow size distribution and spherical morphology can be printed into a pattern having a high density and high resolution. Other deposition methods utilizing a phosphor powder dispersed, such as by using a dispersing agent, in a liquid medium include micro-pen or syringe deposition, wherein the powders are dispersed and applied to a substrate using a pen or syringe and are then allowed to dry.

Please replace Table V at page 77, line 7, with the following amended Table V:

Table V

Example	Precursor Stoichiometry*	Heat Treatment Atmosphere	Weight Loss during Heat Treatment	Crystalline Phases of Final Powder	Relative PL Intensity
BAM-8	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{Mg}_{1.5}\text{Al}_{10}[[\text{O}_x]]$	H_2/N_2	10.4%	BaAl_2O_4	13
BAM-9	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{Mg}_{1.75}\text{Al}_{10}[[\text{O}_x]]$	H_2/N_2	8.5%	BaAl_2O_4	18
BAM-10	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{Mg}_{2.0}\text{Al}_{10}[[\text{O}_x]]$	H_2/N_2	8.2%	BaAl_2O_4	7
BAM-11	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{MgAl}_{12}[[\text{O}_x]]$	H_2/N_2	7.8%	$\text{BaAl}_2\text{O}_4 + \text{BAM}$	42
BAM-12	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{MgAl}_{14}[[\text{O}_x]]$	H_2/N_2	7.2%	BAM	37
BAM-13	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{MgAl}_{16}[[\text{O}_x]]$	H_2/N_2	5.9%	BAM	29

Application Serial No. 10/730,756
Response to Office Action dated April 18, 2006

BAM-14	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{MgAl}_{20}$ [[O _x]]	H ₂ /N ₂	4.5%	BAM	14
BAM-15	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{Mg}_{0.89}\text{Al}_{13}$ [[O _x]]	Air	12.0%	BaAl ₂ O ₄ + BAM	--
BAM-16	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{Mg}_{1.11}\text{Al}_{13}$ [[O _x]]	Air	13.6%	BaAl ₂ O ₄ + BAM	--
BAM-17	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{MgAl}_{13}$ [[O _x]]	Air	7.9%	BaAl ₂ O ₄ + BAM	--
BAM-18	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{MgAl}_{12}$ [[O _x]]	Air	7.0%	BaAl ₂ O ₄ + BAM	--
BAM-19	$\text{Ba}_{0.95}\text{Eu}_{0.05}\text{MgAl}_{14}$ [[O _x]]	Air	7.0%	BAM	--

* - exclusive of oxygen